O P T I M U S **C** GENERATOR
R e l e a s e 1.1 with XRGSCOPE 3.14

This HELP-manual is in the order of the screens and commands coming up if XRGSCOPE is started on the service PC. It explains the functions and modes in the order of their appearance and explains all functions including the ones which can only be accessed with the PC hardkey.
They are indicated in chapter FAULTFINDING of the SERVICE MANUAL (generator documentation = doc).

Text explanations in *'italic letters and quotation marks'* refer to **bold and underlined** screen or item names.

Note:

Whenever using XRGSCOPE, start from DOS if possible. Using WINxx might cause some unexpected problems (WIN3.x also) depending on the number of multitasking background programs.
XRGSCOPE runs best under pure DOS. If it runs in a DOS-box under WIN 3.x, the file dosprmpt.pif (or possibly a special selfmade xrgscope.pif) should be set to exclusive and full-screen-mode, which can be done with the PIF-EDITOR.
XRGSCOPE is not tested with WIN95/98/NT. In case of problems they may be solved if WINxx is started in MSDOS-MODE.
To ensure safe loading procedures from and to the generator screensavers and any kind of power management must be switched off. These should never be active when using XRGSCOPE.

Unpacking of the installation disk data files

There is a disk with the documentation. It has a selfextracting **OMC024xx.EXE** file. A free disk space of 4 MByte is required.
Create a directory on the PC harddisk (e.g. C:\OPT_C_11) and load the .EXE file of the installation disk to the new DIR (copy A:*.* C:\OPT_C_11). Run the .EXE file to inflate the programs.
Note! Since OMC 02412.EXE a new tube firmware TUBE_R3.TDL exists to drive the new version of rotor control 4512 104 71421 with firmware 4512 113 22322. It also runs on all predecessor rotor controls 4512 104 71401...6 with firmware 4512 113 22312.

Loading of the Release 1.1 firmware to the Flash PROMs on CU EZ139

Generators (preinstalled) are always delivered with the last firmware version, while replacement / spare CU-PCBs are always delivered with Optimus RAD-R/F Release 3.3.

In this case Optimus C Rel. 1.1 has to be loaded to the flash PROMs first. (The generator can be programmed afterwards)

!! Never use NORTON commander to start flash loading !!
It might take > 6 hours instead of 15...50 minutes.

- Switch off the generator.
- Remove system connections CAN EZX42/43 and signal bus EZX23.
- Select the OPT_C_11 XRGSCOPE DIR.
- Establish the data cable PC (COM1 or 2) <<>> generator CU EZ139 X5.

- Start either program
  FLASH1.BAT (COM1) or
  FLASH2.BAT (COM2).

- Wait, until PC displays:

Attempting link to device

- Switch the generator on.

Now the firmware will be loaded automatically to the Flash-PROMs on CU EZ139. It takes 15...50 minutes depending on the processor type of the PC.

- !! After the end of the loading procedure (100%) one must wait until the message

Flash Loaded
<OK>

comes up.

It might take up to 10 minutes before the message appears !!

After pushing <Return> the PC will display a command line

Restart normal.

The normal communication to the generator can be started now.
If the time between 'Flash Loaded <OK>' and pushing of <Return> on the PC takes too long <ESC> has to be pushed once or twice to start the generator-PC communication.

If an original CMOS still exists, the Cockpit desk will come up as usual with the parameters and settings when the generator has been switched off.

If nothing has been programmed or if e.g. the mA_control PCB has been exchanged and no tube has been programmed, the Cockpit will only display PHILIPS OPTIMUS.
Then the generator has to be programmed according to the local configuration (e.g. tube type, film-screen combinations ...).

File

Whenever XRGSCOPE is started, the program will first of all display the screen CUSTOMER.TDL (with what is actually stored in CUSTOMER.TDL, details see *'Customer Data'*). The default screen is empty.
During every log-in an entry **00S✳** will be logged in the error log index to indicate service access to the gene-rator. To prevent from too many 00S✳ entries one can leave XRGSCOPE active on the PC and turn the generator off. After turn-on the communication PC <> generator starts at the same screen which is open on the PC (even if the communication cable has been removed when the generator was off).

- **Open Data File**

  Allows to open data files of the current DIR from which XRGSCOPE has been started. Files can be opened and the content can be displayed. Some files might be too big to be displayed, then a screen **table too big** will come up. It depends on the free PC memory (DOS based) and the file size.
  To enter in the file list push the <TAB> button and select with the cursor buttons or type in the file name. If xxx.TDL files shall be displayed from a floppy disk, just type A: in the command line and the file list will be displayed. *'Open Data File'* can also be used offline.

- **Start Macro Recording = Alt+R** Of no practical use for programming, to be continued.

- **Execute Macro = Alt+E** Of no practical use for programming, to be continued.

- **Load Macro = Alt+L** Of no practical use for programming, to be continued.

- **Save Macro = Alt+W** Of no practical use for programming, to be continued.

- **Customer Data**

  Whenever data screens like *'error log index'* are saved to a xxx.TDL file (function **Save: <F3>** appears in the bottom line), *'customer data'* being saved in the CUSTOMER.TDL file are attached to the saved data screen. It helps to separate saved screen files of different sites, customers or rooms in the same hospital. Site data must be stored in CUSTOMER.TDL file, only data of this file are attached to the saved screens. One can save site specific customer data in self-made files using <F3>. To recall site data use the **Load: <F4>** function. It does not appear in the bottom command line, but it is possible to do so.
  Procedure: Either the CUSTOMER.TDL screen is open or open the *'Customer Data'* screen. Push <F4> and select a site data file. The old data screen comes up. Now save this screen with <F3> typing in CUSTOMER as file name.

  - **Customer Name:**
  - **City / State:**
  - **Country:**
  - **Generator Location:**
  - **Generator Serial Number:**
  - **Generator 12 NC:**
  - **Memo1:**
  - **Memo2:**
  - **Memo3:**

- **Exit Program = Alt+X**

  To leave XRGSCOPE back to DOS (or WINxx).

Optimus C >> Program

Explanations:
A down-pointing arrow at the right side end of a programming line allows a selection of values or options after pushing <ENTER>. Select items with the cursor up-down and push <ENTER> or <F2>.

[*Square bracket* **]** *fields allow to enter values. Value fields without brackets are read only.*

- **Date and Time** has to be programmed
  - with a new CU PCB
  - after NVRAM erase (battery off)

- **Mains data**
  - **U_mains_nominal [V]** available values = 380 / 400 / 440 / 460 / 480 V
    default value = 400V
    (for 415V select 400V)
  - **Ri_mains [mOhms]** range of mains impedance = 0...500 mOhms
    default values: 50kW = 200 mOhms
    65kW = 100 mOhms
    80kW = 100 mOhms

!!! **A mains resistance value of >300 mOhms must not be programmed,**
!!! **otherwise the system does not get ready condition !**

!! It is important to select (U) and type in [Ri] the true values. The calculation of the
!! kV_control for the duty cycle to drive the IGBT's is based on that.

Power reduction table:

			380V	**400V**	**440V**	**460V**	**480V**
Ri for	<	300mOhms	50kW	50kW	50kW	50kW	50kW
Optimus	<	350mOhms	40kW	50kW	50kW	50kW	50kW
50kW	<	400mOhms	30kW	40kW	50kW	50kW	50kW
Single	<	450mOhms	30kW	30kW	40kW	40kW	40kW
Converter		500mOhms	30kW	30kW	30kW	30kW	30kW
Ri for	<	150mOhms	100kW	100kW	100kW	100kW	100kW
Optimus	<	200mOhms	80kW	80kW	100kW	100kW	100kW
65/80kW	<	250mOhms	65kW	65kW	80kW	80kW	80kW
Double	<	300mOhms	50kW	65kW	65kW	65kW	80kW
Converter	<	350mOhms	40kW	50kW	50kW	50kW	65kW
	<	400mOhms	30kW	40kW	50kW	50kW	50kW
	<	450mOhms	30kW	30kW	40kW	40kW	40kW
		500mOhms	30kW	30kW	30kW	30kW	30kW

The max kW limit is programmed in the function key EZ139 D38
(depending on the customer order, see STAMMKARTE on frontal kV power unit).

- **Tubes**
  - **Tube 1**...3 **only tube 1 possible with OPTIMUS C**
    - **Tube 1**...3 **Data Set**

After 35 sec of **Reading** (spinning bar) the screen **Load Data from Disk** comes up, offering the default **TUBE_R3.TDL**. file

With <OK> a screen **Availabe Tubes (Rel.3 Format)** offers a selection of all available tubes in non-cooled housings ROT350 (250W) or water cooled housings ROT351 (450W).
After tube selection a screen **Analysing** will come up, followed by **Transmitting** and with **Percent transmitted** how much of file has ben loaded to the generator. Wait until the PC comes up with the message to reset the generator:

D O NOT R E S E T B E F O R E !!

- **Tube 1**...3 **Speed Selection** range = 3000...9000 rpm

  - Exposure rotation [RPM]: >> the speed for every technique
  - Fast Exposure rotation [RPM]: >> is automatically taken from the
  - Fluoroscopy rotation [RPM]: >> tube data file

  Fluoroscopy without rotation is not possible.

  !! All stators have to be connected as an SRO tube, see doc INSTALLATION **!!**
  For special tubes see INSTALLATION.

- **Tube Limits** (only **[value]** fields can be modified)

  Tube: 1 ... 3

  Max. Tube Voltage Limit [kV]: range: **[20...150]** kV

  The value must be set to the max kV of the tube (see tube label). If a tube arcs during adaptation the max kV value can be reduced (or repeat the break in procedure, see doc INSTALLATION). After adaptation the programmed value is the max value which can be selected on the Cockpit , even if the value will be increased thereafter (without any effect) in this field. The reduced value appears in *'Adapted To [kV]:'*.
  If a tube has been adapted with a higher kV than it should be used for (e.g. veterinary surgeons max 100kV) the limit must be programmed in this data field.

  Focus: **small**, **middle**, **large**

  The middle focus would be a third physical filament in a tube (not yet available), it is **not** the VARIO focus.

  Min. Tube Voltage Limit [kV]: range: **[20...150]** kV

  All standard diagnostic tubes of the installation tube file have a default min kV value of 40 kV. It can only be modified in a range > 40kV as 40kV it is the default min value.

  Adapted To [kV]: gives the max available kV value on the Cockpit (after adaptation)

  If this value shall be increased, first the *'Max Tube Voltage Limit [kV]:'* must be increased. Then the tube has to be readapted afterwards to have the higher kV available for application.

  Min. Tube Current Limit [mA]: range: **[0.1 ... 2000]** mA

  0.1 mA is the lowest current of the Optimus (fluoro). The lowest mA value one can select for radiographical exposures is 1 mA.

  Max. Tube Current Limit [mA]: range: **[0.1 ... 2000]** mA

  The kV dependent max mA value is automatically limited by the tube type **and** the generator version:
  OMC50 kW max = 650 mA OMC65 kW max = 900 mA OMC80 kW max = 1100 mA

  The max tube mA value is initially set by the tube data set of the tube file, it will be adapted to the individual focus limits during adaptation (within the total tube limits), the max mA table can be seen in *'Select Unit' >> 'FU_mA' >>'Programming'*.
  !! If there is any applicational reason to modify the max mA value it is possible, but it will
  !! influence all registration devices.

- **Capacitance Tube Connection** - formula and table = see doc INSTALLATION

  - **Tube 1** ... 3 **Capacitance on Tube Connection [nF]:**

    range = 2.000nF - 10.000nF, a value of 5.300 nF should never be increased to prevent from damages during tube arcing.

- **Tube Operating Modes**

  - **intermediate boost:** (intermediate boost explanation see doc FAULTFINDING functional unit FU_mA)

    enable = double boost mode (default)

    Active, if emission current (Ie) in a range of **[** Ie max - 20% **] ... [** Ie max **]**
    Inactive, if emission current < **[** Ie max - 20% **]**
    and if activated by Cockpit (not yet implemented)

    Recommended for **childrens** hospitals and **casualty** rooms (long preparation times).

    disable = single boost mode

  - **rotation prolongation after prep:**

    disable = tube stops immediately after exposure end or let go of the PREP handswitch if PREP has been started from standstill (default)

    enable = Once started with PREP, the tube keeps rotating for 30 seconds after the last let go of the PREP position as long as no exposure has been switched. The tube finally stops if an exposure has been switched (or after 30 sec).

    Recommended for **DUO-D, childrens** hospitals and **casualty** rooms.

    Exposure series have to be started with a fluoro command, afterwards the tube keeps 9000rpm exposure speed for 30 seconds after the last let go of the prep or fluoro switch.

- **Disable Tube**

  Must not be used at Optimus C.
  In case the tube type shall be changed use function *'Tube 1 Data Set'*. The previous file will be overridden.

- **Dose Rate Control**

  - **AMPLIMAT**

    - **Sensitivity:**

      high Sensitivity of basic interface chamber signal amplifier is 4 times higher.
      Only possible with PCB EZ150 version 4512 108 05964 and higher, in this case jumper W4 must be in position 1 (X4). (Some PCB layouts have a X10 print)
      - *'high'* should be set in case of **TDC** (**T**omo **D**ensity **C**ontrol) option (only with PCB EZ150 >= 4512 108 05964 with jumper W4 in position 1 (X4)).
        Exception: If at least one of the Film Screen Combinations has a speed of <200, *'low'* must be selected.
      - *'high'* should be the recommended range if all film-screen-combinations of the system are >= 200 (only >= 4512 108 05964 with jumper W4 in position 1 (X4)).

      The max density voltage *'U_off'* is 10V. Therefore a film-screen-combination with a low sensitivity might saturate the dose rate control input and it will not find the switch-off point.

      low (default)

      'low' must be the recommended range if at least one film screen combination of the system is < 200 (only >= 4512 108 05964 with jumper W4 in position 3 (×1)).

      The chamber signal = density voltage "U off" to the dose rate control input of CU (see *'DRC Logging' - 'AEC' - 'AEC Calculation'*) should not increase 10VDC.

    - **Chamber 1** ... 5

!!! Special remark for Optimus C with DuoDiagnost systems:
- Only 2 chambers
  chamber 1 = EZX21 = Bucky
  and
  chamber 2 = EZX22 = wallstand
  are available for DuoD.
- Only 5 film-screen combinations can be controlled by Cockpit.
  Data sets of film-screen combinations should be programmed at both chambers.
  To be available at chamber 2 the data set **must** be programmed at chamber 1 even if it might be used for wallbucky only.
- Dose settings must be adjusted for each data set at both chambers.

  - **Data Set 1** ... 5

    - **DRC Handling / Start Automatic DRC Processing**

      - **<OK>** Every empty line of this window has to be filled:

        >> For PCR/FCR/KCR/ADC (computed radiograpy or dry cassettes see
        >> details **(1) to (6)**.

FILM	default data file	:	**FILM.TDL**	**(1)**
SCREEN	ditto	:	**SCREEN.TDL**	**(2)**
CHAMBER	ditto	:	**CHAMBER.TDL**	**(3)**
CASSETTE	ditto	:	**CASSETTE.TDL**	**(4)**
SYSTEM CORRECTION	ditto	:	**SYSCOR.TDL**	**(5)**
CORRECTION FACTOR			range = 0.00 ... 9.99	**(6)**

(1) If the film type is not in the default data list, then select one of the film files: **FILM_BL.TDL** (blue), **FILM_GR.TDL** green), **FILM_UV.TDL** (ultra violet). Select the one which matches the sensitivity factor S and RLF compensation.

S is a multiplication factor for the speed type of the screen:
If the screen = 400 and S_film = 0.5, then the total system is 200.

PCR: Select from **FILM.TDL :** **X-CONSTANT RLF=1**

(2) If the screen type is not in the default data list, then another file can be selected: **LUMAT.TDL**.
This file contains the luminous groups LG with different colors and different speeds.

PCR: Select from **LUMAT_LG.TDL :** **LG06 Sxxx vi**

(3) The following list gives the PEI-No. of the chambers which can be selected from the data file **CHAMBER.TDL** and the typical dose request values.

PCR: Select from **CHAMBER.TDL :** the installed chamber type

	name in data set	[µGy/V]	supply EZ150 W2/W3 15V / 40V
typical Hybrid	9803 509 . typ.Hybrid	5.85	only 40V
typical ALC	9890 000 ..1 typ.ALC Pb	5.24	15V or 40V
typical ALC	9890 000 ..2 typ.ALC Ag	5.24	15V or 40V
Bucky	9803 509 10002	5.85	only 40V
Bucky	9890 000 01611	5.24	15V or 40V
Bucky	9890 000 01612	5.24	15V or 40V
Childrens Bucky	9803 509 10102 Ch.Bucky	5.41	only 40V
Childrens Bucky	9890 000 01621 Ch.Bucky	4.81	15V or 40V
Childrens Bucky	9890 000 01622 Ch.Bucky	4.81	15V or 40V
Chest	9803 509 50002 Chest	5.85	only 40V
Chest	9890 000 01661 Chest	5.24	15V or 40V
Chest	9890 000 01662 Chest	5.24	15V or 40V
Scopomat 42/52	9803 509 30202 Scopo42/52	5.68	only 40V
Scopomat 42/52	9890 000 01651 Scopo42/52	5.08	15V or 40V
Scopomat 42/52	9890 000 01652 Scopo42/52	5.08	15V or 40V
Scopomat 63/73	9803 509 30002 Scopo63/73	5.32	only 40V
Scopomat 63/73	9890 000 01631 Scopo63/73	4.81	15V or 40V
Scopomat 63/73	9890 000 01632 Scopo63/73	4.81	15V or 40V
Scopomat 71/74	9803 509 30102 Scopo71/74	5.15	only 40V
Scopomat 71/74	9890 000 01641 Scopo71/74	4.63	15V or 40V
Scopomat 71/74	9890 000 01642 Scopo71/74	4.63	15V or 40V
Neuro Diagnost	9803 509 50102 Neuro D.	8.06	only 40V
Neuro Diagnost	9890 000 01671 Neuro D.	7.14	15V or 40V
Neuro Diagnost	9890 000 01672 Neuro D.	7.14	15V or 40V
Cranio Diagnost	9803 509 50602 Cranio D.	8.06	only 40V
Cranio Diagnost	9890 000 01681 Cranio D.	7.14	15V or 40V
Cranio Diagnost	9890 000 01682 Cranio D.	7.14	15V or 40V
Puck 35x35	9803 509 60002 Puck 35x35	4.37	only 40V
Puck 35x35	9890 000 01691 Puck 35x35	3.94	15V or 40V
Puck 35x35	9890 000 01692 Puck 35x35	3.94	15V or 40V
Extremities	4512 102 80261 Extremity	10.10	only 40V
Extremities	4512 104 47621 Extremity (9803 509 51202)	1.14	15V or 40V
Junior Diagnost	4512 103 06661 Junior D. (9890 509 51202)	3.32	only 40V

	name in data set	[µGy/V]	15V / 40V
Junior Diagnost	4512 104 47621 Junior D. (9803 509 51202)	1.14	15V or 40V
Mammo Diagnost	4512 127 98802 MammD.	3.32	only 40V
Mammo Diagnost	4512 127 98803 MammD.	1.40	15V or 40V
Mammo UCBC	4512 104 18811 MamUCBC	3.32	only 40V
Mammo	4512 104 47621 Mammo (9803 509 51202)	1.40	15V or 40V
	X-CONSTANT DV=1VOLT	5.00	

(4) normal cassette (default) Al double sided screen (factor 1.00)
carbon fiber cassette double sided screen (factor 1.12)
single side screen normal cassetteAl (factor 0.50)
single side screen carbon fibre cassette (factor 0.56)
factors can not be changed

PCR: Select from **CASSETTE.TDL : normal cassette(def)**

(5) no correction (ISO9236-1) = linear kV behaviour

PCR: Select from **SYSCOR.TDL : no corr.(ISO9236-1)**

low-kV-correction = correction factors kV dependent:

kV	40	50	60	70	80	90	100	120	140	150
factor	0.7	0.78	0.89	1.0	0.99	0.95	0.92	0.94	0.98	1.0

(6) The default value is 1 representing a density of 1. If no PC-hardkey exists, this field is the only chance to modify the density of the programmed FSC.

PCR: 1

If the value has to be changed to the desired density after a test exposure and density measurement, the entire set has to be programmed again.
If the PC-hardkey exists, use the function *'Start Automatic DRC Processing' >> '<CANCEL>'* and keep the correction value on 1, if not use the following formula:

$$\frac{\text{desired density}}{\text{measured density}} = \text{new [`CORRECTION FACTOR']}$$

The name of the FSC is the abbreviation of the resulting speed and the color of the film screen combination. There might be names like **B400** for a blue 400 speed combination or **G200** for a green 200 speed combination. The name is given by the screen data set.
The name can be changed (only with the PC-hardkey), see *'Start Automatic DRC Processing' = '<CANCEL>'* or *'<ESC>'*.
The name **must** be changed if different film screen systems with the same resulting name exist. A change from one G200 to a second one can not be recognized.
Combinations of systems with different colors can not be programmed (even if they exist).

- **<CANCEL>** or: use <ESC>

Only two values of the *'Data Set'*s of the *'Chamber'*s should be changed: *'Abbreviation'* and *'Dose of FSC'*.
All others **must not** be changed (e.g. all kV dependent characteristics).

If digital cassettes / imaging plates (PCR/FCR/KCR) type the desired sensitivity (e.g. PCR200) in the *'Abbreviation'* field.

The value *'Dose of FSC [µGy]:'* = K_s must be calculated:

$$\frac{1000\mu Gy}{\text{speed system}} = K_s \qquad \text{example:} \quad \frac{1000\mu Gy}{200} = 5\mu Gy$$

Abbreviation:

The name of the film screen combination can be changed into any 6 digit string.
An FSC can be erased by filling the name field with blanks,
but: !!
There should **never** be a gap in-between the FSC data sets of a chamber. If only one FSC is used, it **must** be on data set 1, the second **must** be on 2 etc. If e.g 4 data sets are active and the 1st will be blanked, none of the FSC's can be selected and AEC is no more available.
If any FSC will be removed from the last position all APR linked to this FSC have to be programmed to any other still existing FSC, otherwise no FSC will be displayed on the desk. When these APR are changed to another FSC the background mAs values have to be adapted to the FSC sensitivity.

Cockpit will send a message that the data set could not be found.

Dose Request Chamber [µGy/V]: range: 0.50...32 µGy/V

Dose of FSC [µGy]: range: 0.45...100 µGy

The initial value *'Dose of FSC [µGy]:'* of the *'DRC Handling / Start Automatic DRC Processing'* (calculated by XRGSCOPE in the service PC) is to achieve a density of **1.0**. It can be changed into any other desired value, e.g. 1.5.

$$\frac{\text{desired density}}{\text{measured density}} * \text{default } \textit{[Dose of FSC]} = \text{new } \textit{[Dose of FSC]}$$

- **Image Intensifier**

  The **II** lead time, density voltage correction (default 1V), and the dynamic factors can be modified if necessary.

- **Fault Exposure Detection** (not yet active)

  - **AEC** Detailed explanation and sketches see doc FAULTFINDING

    off = No 4% dose supervision at 10% of the backup exposure time, automatically off after APR overriding
    on = (default) At 10 % of the backup exposure time (600 mAs or 4000 ms) DRC detects if at least 4% of the expected dose have been measured. If not, the exposure will be switched off by CU.

- **TDC** Detailed explanation and sketches see doc FAULTFINDING

  off = No 4% dose supervision at 10% of the backup exposure time, automatically off after APR overriding

  on = (default) At 10 % of the backup exposure time (APR mAs value, tomo time > 1000ms, not before 250ms) DRC detects if at least 4% of the expected dose have been measured. If not, the exposure will be switched off by CU.

- **CONT** factors for continuous fluoroscopy can be modified:

  scantime_TV [ms]: default = 20 ms (for 50 and 60 Hz)
  range = 0 ... 60000 ms

  scantime_TV valid: **yes** = default
  must be *'yes'* without CAN driven R/F system controller
  no = only possible with a CAN driven R/F system controller

  P_max_EDL [W]: default = 250W
  range = 0 ... 9000 W, max entrance dose limitation, active, if (SID < xx cm)
  not applicable for DUO DIAGNOST

  TV_pos_limit [V]: default = 6.885 V
  range = +3 ... +7.5 V ADC input of TV chain

  TV_neg_limit [V]: default = -6.885 V
  range = -7.5 ... -3 V ADC input of TV chain

- **Application Limits**

  - **X-Mode Limits**

    Limits can be modified within the range of the value fields. The displayed default limit values are higher than the values which can be selected at the Cockpit.
    Values should not increase the local regulation limits.

    - **Min. Time Limit [ms]:**

      The shortest exposure time possible is 1ms.

    - **Max. Time Limit [ms]:**

      The max exposure time which can be selected at the Cockpit is always **16000** ms.
      If **tomo** is selected the max exposure time is **6000** ms.

      !!! The max time limit for AEC must not be shorter than 4000 ms, 6000 ms for TDC !!!
      Otherwise error 00L3 comes up and the generator might be dead afterwards.

    - **Min. Current Time Product Limit [mAs]:**

      0.5 mAs is the lowest value one can select at the Cockpit (any non-AEC technique **RUIT** = kV-mA-ms, **RUQ** = kV-mAs, **RUQT** = kV-mAs-ms).

    - **Max. Current Time Product Limit [mAs]:**

      AEC = AEC falling load**, AECF** = AEC fixed current and **TDC** = Tomo Density Control techniques have a default **max mAs** limit of **580 mAs** programmed to meet the HHS limit of 600mAs (AEC and AECF use the same limit).

Even if the non-AEC techniques **RUIT, RUQ, RUQT** show 1000mAs as default limit, the absolute limit which can be selected at the control desk is **850mAs**.
It can also be selected in HHS countries which are limited at 600mAs for AEC exposures.

- **Thoravision Limits**

  Not applicable with DUO DIAGNOST.

  Table of default max mAs values (kV dependent) to prevent an over-saturation of the Thoravision detector drum (**memory effect**).

- **Overload dependent Limits** for continuous fluoro

  Max. current for conti. fluoro [mA]: range = 3 ... 20 mA

  Max. current during overl. for conti. fluoro [mA]: range = 1 ... 3 mA

  overload conditions, (red traffic light on only):

  - tube housing temperature contact open
  - tube temperature supervision (calculated) detected overload

Optimus C >> Adjust

- **Adjust**

  - **Tube Adaptation**

    The tube should be properly conditioned before starting the adaptation procedure.
    Break-in procedure see doc INSTALLATION chapter Tube conditioning.

    Tube adaptation includes
    1) the measurement of the mA offset of
       - the kV measuring circuit
       - the emission current voltage /frequency converter
    2) the measurement of the individual standby filament current
    3) the kV dependent filament / emission current bahaviour
    4) the boost adaptation to calculate the positive and negative boost (details see doc FAULTFINDING)

    in one procedure.

    Press <RETURN>

    An opening screen asks to wait 20 seconds after the screen coming up thereafter has been <TRANSMIT>ted with <F2>.

    Tube: **1st Tube**
    2nd Tube not applicable
    3rd Tube not applicable

    Focus: **small**
    medium a tube with a (third) medium filament does not exist yet, it is **not** VARIOfocus
    large

    After <TRANSMIT>

    Cockpit displays **Adaptation X-Ray tube** (locally programmed language).

    Ready returns (waiting time is in the order of 15 seconds).

    Now push PREP and EXP button at the control desk or use footswitch.

    The generator will switch about 125 exposures for each focus. The radiation sign at the desk will indicate exposures and a beep will be audible at the end of every exposure.
    There is no display of the actual kV parameters during adaptation.

    The termination of the adaptation procedure will be indicated at the PC screen (and a beep from the PC will be audible):
    Before continuing the generator must be reset.

    Both small and large focus must be adapted to use VARIOfocus. APR using VARIOfocus can not be selected as long as both, small and large are not adapted.

    A non-adapted focus will be indicated at the Cockpit screen.

- **CAN Auto Configuration** (not required for Optimus C)

  Start function: Update Generator Config:

  <OK> gives the command for CU to scan on the internal generator CAN bus and update the generator CAN member list (assign units on the list).
  Minimum configuration of an OPTIMUS (see also *'Faultfind - Power ON Results – Internal CAN Configuration'*:
  FU_mA (EZ119), **FU_kV** (EZ130), **FU_CU** (EZ139), **FU_CIE** (EZ150) **FU_RC_a** (EY100).
  Other units are not applicable for DUO DIAGNOST.
  CU updates the member list during the very first turn-on by itself.

  <CANCEL> or <ESC> nothing changes

- **Area Exposure Product** Not applicable for DUO DIAGNOST

  - **Specific Yield of Tubes**

    - **Specific Yield of Tube 1**...**3**

      Procedure to measure and modify the specific tube yield see doc ADJUSTMENTS. The default yield data table is on the installation disk: **RE_YIEL.TDL**.

    - **Add Filter Correction Table** to adjust deviations of the default filter correction tables of the (additional) homogenous GALILEO collimator filters

      - **2 mm AL** The default data table is on the installation disk: **RE_2AL.TDL**.
      - **1 mm AL + 0.1 mm CU** The default data table is on the installation disk: **RE_01CU.TDL**.
      - **1 mm AL + 0.2 mm CU** The default data table is on the installation disk: **RE_02CU.TDL**.

    - **Wedge Filter Correction Tables** to adjust deviations of the default filter correction tables of the GALILEO wedge filters (not yet available)

      - **Wedge 1** The default data table is on the installation disk: **RE_WED1.TDL**.
      - **Wedge 2** The default data table is on the installation disk: **RE_WED2.TDL**.
      - **Finger Wedge** The default data table is on the installation disk: **REF_FING.TDL**.

- **Dose Rate Control**

  - **TDC Amplimat**

p gain factor (def.50):	range = 0...100	defaut = 50
i gain factor (def. 8):	range = 1...100	default = 8
d gain factor (def. 5):	range = 1...100	default = 5
min sample time (def.40ms) [ms]:	range = 25...60ms	default = 40ms
mul. with gain factor 0.625...1.5 (def.1):	range = 0.625...1.5	default = 1

  - **Amplification gain**

    - **TDC** gain factor tomo density control

      gain factor 0.625...1.5 (def.1): range = 0.625...1.5 default = 1

- **CONT** gain factor continuous fluoroscopy

  gain factor 0.5...2 (def.1): range = 0.5...2 default = 1

- **CONT kV mA manual**

  LOCK IN: **LOCK** = for dose adjustment procedures, this function replaces the kv and mA potmeters
  automatically disabled after reset

  UNLOCK = default or after soft reset

  U[kV]: range = 0...200 kV default = 70 kV
  I[mA]: range = 0...2000 mA default = 1 mA
  the value **must not** be **< 0.1mA** to prevent from malfunctions of the generator
  DR set [µGy/s]: range = 0.001...2.0 >> the '✳✳✳✳✳' appearing in these two >> f ields
  DR measured [µGy/s]: range = 0.001...2.0 >> have to be replaced by a dose value

  >> Procedure for II input dose adjustments:
  set *'LOCK IN'* to *'LOCK'*, type in kV and mA values, type in DR (dose rate) values (use the same value for the first time), switch on fluoro, type in the measured DR value, <TRANSMIT> the data sreen, open the screen again - it will display a new mA value to achieve the required dose rate

- **Boost Adaptation** Boost adaptation is part of the automatic *'Tube adaptation'* procedure. If it might be necessary (no reason known yet) this function can be used, normally: ignore.

Optimus C >> Accept

- **Backup**
  - **CU Complete**

    The default backup name **Backup File Name: CUBACKUP.TDL** (or A:\filename <RETURN>) can be changed into any other file name (e.g. **CU99xxxx**.TDL representing the generator serial number). A disk space of 700 kByte is required. It takes about 8...15 minutes to save the data to the floppy / harddisk.
    The path (harddisk) will automatically be taken into account. It is also possible to type **A:\filename** <RETURN> to load the backup files directly to a floppy disk even if XRGSCOPE is used from the harddisk.

- **Restore**
  - **CU Complete**

    Load Data from Disk offers the default **File Name: CUBACKUP.TDL**
    or type in either **A:\filename** <RETURN> or just **A:** <RETURN> and select a file.

    The path of a harddisk will automatically be taken into account.
    It takes about 15-30 minutes to restore the data (PC type dependent). If the spinning bar during the loading procedure seem to turn very slowly then stop the procedure. Type **<ALT> x** to leave the XRGSCOPE program and type in the following command in DOS: XRGSCOPE D=5 , the smallest value should be 1 for a PC processor with a low speed.
    Another reason for a slow transmit speed might be if XRGSCPE has been started from NORTON.

    !!! Date and Time must be set after restore is finished. **!!!**

- **Inspect**
  - **Tube Statistic**
    - **Tube 1**...3 **Statistic**

      only **tube 1** applicable

      exposure counter : displays the number of exposures
      fluoro counter : displays the number of fluoro requests
      for future use [s] :
      for future use [s] :
      for future use :
      for future use :
  - **Generator Statistic**

    for future use [s]: to count the switch on time, not yet implemented
  - **Type of Tube 1**...**3** only **tube 1** applicable

    Tube name + housing type as programmed from the tube data file.
    Empty field: no tube programmed.
    only **tube 1** applicable

- **Clear NVRAM**

  !!! Attention !!! Erases the entire CU Complete once <ENTER> was given.

Optimus C >> Faultfind

- **Power ON Results**

  - **Options**

    This screen displays all options programmed in the function key EZ139 D38 (compare with STAMMKARTE on the cover of the frontal kV_power unit).

  - **Internal CAN Configuration**

    This screen displays the actual status of the assigned Functional Units on the internal generator CAN. The CU as controller of the generator is not part of this list.

    b = basic unit, **must** be in
    x = not applicable

FU kV:		[ ]	**b**	**kV_control EZ130**
FU mA a:	[ ]	**b**		**mA_control EZ119**
FU mA b:		[ ]	x	2nd mA_control
FU mA c:	[ ]	x		3rd mA_control
FU mA d:		[ ]	x	4th mA_control
FU CIE:		[ ]	**b**	**C**entral **I**nterface **E**xtension = **Basic interface EZ150**
FU HI a:		[ ]	x	**H**uman **I**nterface = operating panel C300
FU HI b:		[ ]	x	2nd operaring panel
FU RC a:		[ ]	**b**	high speed **Rotor Control EY100**
FU RC b:		[ ]	x	2nd high speed rotor control
FU RC c:		[ ]	x	3rd high speed rotor control,
FU AD a(1WA):	[ ]	x		adapter for 4 aux. units WA (Bucky/Tomo) 1WA102
FU AD b(2WA):		[ ]	x	adapter for 4 aux. units WA (Bucky/Tomo) 2WA102
FU AD c(1WB):		[ ]	x	adapter for 4 aux. units WB (R/F + Bucky) 1WB102
FU AD d(2WB):		[ ]	x	adapter for 4 aux. units WB (R/F + Bucky
FU MDO:		[ ]	x	monitor data overlay

    [**01**] = no response from basic unit
    [**2**] = unit (basic and optional) on CAN member list and ok
    [**F0**] = optional unit on CAN member list, but no response during turn-on
    [**FF**] = optional unit not present, FF also appears if a unit is physically installed but has not yet been assigned

  - **SW/HW - Versions**

    This screen displays the actual firmware versions **Release, V**ersion (don't care) and **Level**.
    For the PCB **C**entral **U**nit it also displays the hardware version (must be **2** for Release 3.x).

CU APPL SW:	[**R1**V1**L1**]	4512 114 26911
CU BOOT SW:	[**R0**V1**L1**]	4512 113 27001
FU kV:	[**R3**V1**L1**]	4512 113 26211
FU mA a:	[**R1**V1**L2**]	4512 113 20212
FU mA b:	[- - - - -]	
FU mA c:	[- - - - -]	
FU mA d:	[- - - - -]	
FU CIE:	[**R1**V1**L1**]	4512 113 20311
FU HI a:	[- - - - -]	
FU HI b:	[- - - - -]	
FU RC a:	[**R2V1L2**]	4512 113 22322
FU RC b:	[- - - - -]	
FU RC c:	[- - - - -]	
FU AD a(1WA):	[- - - - -]	

FU AD b(2WA): [- - - - -]
FU AD c(1WB): [- - - - -]
FU AD d(2WB): [- - - - -]
FU MDO: [- - - - -]
CU HW: [**2**]

- **Logging Table**

  - **Error Log**

    - **Error Log Index** gives an overview of the events logged in the FU_CU CMOS.

      Index: [ ]

      Max 50 events can be logged. The last event is always in the highest index number. If all 50 lines are filled, line 50 will log the last event and the oldest event (line 1) disappears.

      Code: [ ]

      Displays the 4 digit code. The fist two digits represent the error source (**F**unctional **U**nit number, HEX format), the last two digits the event mailed by the unit.

      Date of Error: [ ]

      Event entries should have a regular date and time format.
      If the date and time column also contains any letters,
      the clock has not been set
      - after the very first switch on
      - after PCB CU exchange
      - after NV-RAM = CMOS erase of CU
      - possibly after *'Restore'* of *'CU Complete'*

    Error Explanation: [ ]

      Gives a brief explanation of an event.

    - **Select Error Detail**

      Index: [ ]

      After looking through the *'Error Log Index'* one can enter the index number of an event to get the details. The last index number is automatically in the input field. Transmit with <F2>.

    - **Error Log Detail**

      Not every functional unit supports detailed event logs. If event source is not CU, kV (see *'FU*-kV') or mA (see *'FU-mA'*), **FU not supported** will be displayed.

      - **Error Datail of CU**

        - **Error Info** to be continued
        - **Program Trace**

          - **Error Log Clear**

          Start function: Clear Error Log Once sent with <OK> all entries are erased.

- **X-Ray Log**

  - **Tube Temperature Supervision Logging**

    - **Tube Temperature Supervision Temperature Log**

      The tube temperatures are supervised by the TTS calculation model. Every second the temperatures are recalculated and updated in this table. Overload flags (see **part: 23456**) are tube and housing type dependent. Tables disappear with switch off, but actual temperatures will be calculated and updated during switch on or warm start.
      All temperatures should be at 20ºC (basic value) after a long switch-off period.

      04/ X-SEGMENT: Tube Temperature Table

		temperature in degrees centigrade					overload at
time	**tube**	**T(2)**	**T(3)**	**T(4)**	**T(5)**	**T(6)**	**part: 23456**
8193	1	20.0	20.0	20.0	20.00	20.000	0 0 1 0 0 0 0 0 (see table)

      time time table in seconds
      tube tube number (1...3)
      T(2) focal spot temperature
      T(3) focal track temperature
      T(4) anode disk temperature
      T(5) rotor temperature
      T(6) oil temperature

0	**0**	**1**	**0**	**0**	**0**	**0**	**0**
yellow	red		T(2)	T(3)	T(4)	T(5)	T(6)
traffic light condition: green = 0 0 green + yellow = 0 0 yellow = 1 0 yellow + red = 1 1 red = 1 1		1 = standby 0 = exposure	0 = temperature value within the max limit				
			1 = temperature value increased max limit				

    - **Tube Temperature Supervision Load Log**

      This Tube Load Table displays all loads to the tube and housing. The table disappears after switch off or warm start.

time		at which second after turn-on the event has been logged
tube		tube number (1...3)
tube disk energy	[Ws]	energy of an exposure of fluoro loaded do anode disk
peak load	[W]	max peak load
rotor energy	[Ws]	acceleration and brake energy in one package
focus		filament used for the exposure VARIO focus is displayed as large filament at a ratio of 20%, 35% and 50% of small focus, as small with 65% and 80% of small focus

    - **Tube Temperature Supervision Error Log**

      to be continued

  - **Dose Rate Control Logging**

    - **Read Actual Status**

      selected mode:
      time measured [ms]:

last I [mA]:
last U [kV]:
dose relative [%]:
dose offset:
last dose measured:
LOCK IN state:
DRL (dose rate limitation) state:

- **None Automatic Technique Calculation**

U nominal [kV]:
I nominal [kV]:
t nominal [ms]:
Always 2000ms in a non-adapted condition.
C eff ht [nF]:
t corrected [ms]:

- **AEC**

  - **AEC Calculation**

U nominal [kV]:
I nominal [mA]:
t backup [ms]:
C eff ht [nF]:
selected sensor:
dose measurement input:
film screen comb.:
dose nominal [OD]:
dose calculated:
kV factor:
U off [V]:
t corrected [ms]:
t lead AEC [ms]:

  - **AEC Trace**

t sample [ms]
dose nominal
dose actual
dose rate
t dr [ms]
t esti [ms]

  - **TDC**

    - **TDC Calculation**

U nominal [kV] :
I start [mA] :
t backup [ms] :
C eff ht [nF] :
dose measurement input :
film screen comb. :
dose nominal [OD] :
I max [mA] :
I min [mA] :
dose calculated [ms] :
kV factor :
U off [V] :

t corrected [ms] :
number of steps :
time / sample [ms] :

- **TDC Trace**

  idx
  dose nominal
  dose actual
  dose rate
  reg in
  reg out [%]
  new I [mA]

- **CONT**

  - **CONT Calculation Start Value**

    U start [kV] :
    I start [mA] :
    C eff ht [nF] :
    measure_int [ms] :
    max dU [kV] :

  - **CONT Calculation Curve**

    U [kV] :
    I [mA] :
    dr_abs :

  - **CONT Trace**

    act_idx :
    idx :
    delta_dose_rate :
    PID_out factor :
    dr_abs :
    new I [mA] :
    new U [kV] :

- **CU Trace**

  Rel Time
  FG
  Trace Info

- **Select Unit**
  - **FU - mA**
    - **Program**
      - **Read Focus Limits**

Window asks for Focus number. Type in focus number FU-mA (1...6):

focus number FU-mA	filament converter on FU-mA EZ119	focus number CU EZ139 (0..8 = max 9)
1 large focus tube 1	filament circuit **2**	focus number **2**
2 small focus tube 1	filament circuit **1**	focus number **0**
3 large focus tube 2	filament circuit **2**	focus number **5** **not applicable**
4 small focus tube 2	filament circuit **1**	focus number **3** **not applicable**
5 large focus tube 3	filament circuit **2**	focus number **8** **not applicable**
6 small focus tube 3	filament circuit **1**	focus number **6** **not applicable**

After <TRANSMIT> a data screen comes up.

focus : see table *'focus number FU-mA'* above

deinstall :

Umin [kV]: minimum kV value, default 40kV for radiographic tubes,
default data in tube data file
modification with *'Tube Limits'* possible
modified values appear after adaptation

Umax [kV]: maximum kV value, default 150kV for radiographic tubes,
default data in tube data file
modification with *'Tube Limits'* possible
modified values appear after adaptation

Uiso [kV]: focus specific value, default value will be overidden after adaptation
(generator version = max available emission current dependent)
Uiso is the kV value, from which on the filament current can be decreased to drive always the max kV dependent emission current (with rising kV)

Pmax [W]: maximum focus output power, default value in tube data file
value might be different (lower) after tube adaptation
(e.g.SRO33/**100** with Optimus 50: Pmax after adap = 50kW instead of 80kW)

IFmax [mA]: max filament current limit, default value in tube data file
value might be different (lower) after tube adaptation
e.g. Pmax tube > Pmax generator

IFregelmax [mA]: = IFmax + analog offset value for regulation purposes during boost up, typically IFmax + 200mA

Philips tube :

FILsel :

FILcir: physical filament circuit, see table *'filament converter on PCB FU-mA EZ119'* above

I0 [□A]: I0 = max emission current at Umin (typically 40kV = default)

up to I120 [□A]: I110 = e.g. max emission current at Umax (typically 150kV = default)
(I0 equals **40kV**) + (I110 equals **110kV**) = **150 kV**
all values in-between are (default) specified tube data coming from the installation disk data file, values (might) change when modified in the *'Tube Limits'* screen and after adaptation

CU physical fil: CU can handle 9 filaments at max 3 tubes, see table *'focus number CU EZ139 (0..8 = max 9)'* page 21

CU checksum fil:

- **Faultfind**
  - **Logging Tables**
    - **Read Actual Status**

Gives the actual status of the filament circuit. Several entries are possible in the three fields.

foc = see *'focus number FU-mA'* table page 21

static = condition of the filament like:
- FOCini no tube programmed
- normal tube programmed and adapted

dynamic = actual dynamic condition like:
- off
  - no tube programmed
  - single focus tube, this circuit not in use
- standby in standby without error
- ctrl Xray during exposure or fluoro

    - **Read status Trace**

Displays the last 10 activities with FU_mA. All fields have several entries possible.

details to be continued

time relative time [ms] of the last 10 status changes

foc see *'focus number FU-mA'* table page 21

old sta old static condition before status change

old dyn. old dynamic condition before status change

signal status change command

new sta new static condition after status change

new dyn. new dynamic condition after status change

- **Read Error**

  - **Error: Info**

    Displays an error code and sometimes the reason for the error entry.

    class: Three error classes are possible:

    - warning: Something happened being worth to be logged in the trace. Warnings are logged, but they are not displayed on the Cockpit and do not lead to a switch off of the exposure. If analog measurements e.g. increase the first limit, there will be an internal warning entry, which can be fixed during maintenance.
    - error: An error always leads to an exposure off command. The event will be displayed on the Cockpit, which can be reset with the the **reset** labelled button or with any other.
    - fatal: Fatal errors might be displayed on the Cockpit, but not in all cases. If there is a communication breakdown a fatal error might not be possible on the CAN bus. As all error entries are logged in CU the information has to get to CU. None of the units has a memory to keep the fatal condition when the generator has been turned off. So the information is lost. The only way to log it is by pushing the reset button at the CU PCB EZ139 to warm reset the generator. Then the fatal error condition might be trasmit to CU.

    error code: The error code is a 4 digit code.
    The first 2 digits represent the functional unit, see table in doc FAULTFINDING.
    The last 2 digits give details of the error code, see details in doc FAULTFINDING.

    error explanation: gives a brief explanation

    task name: is the task name of the functional unit process during the error
    ignore for troubleshooting

    procedure name: is the procedure name of the FU process during the error
    ignore for troubleshooting

    previous warning: might display a previous message

    previous explanation: might display a previous explanation

    parameter: might be displayed if available

  - **Error: Actual Status**

    Displays actual status during error: see *'Read Actual Status'* page 43.

  - **Error: Status Trace**

    Displays status trace during error, only 3 entries: see *'Read Status Trace'* page 22.

- **Error: HW Set Values**

If SW set (filament circuit 1) [mA]: filament current setpoint
filament circuit: see table page 21

If SW set (filament circuit 2) [mA]: filament current setpoint
filament circuit: see table page 21

FI ON (filament circuit 1) :
on = filament circuit 1 active (small focus)
- if all ready conditions present, activates triac V36 on EZ119 for intermediate DC circuit, but only in case of a two filament tube

off = filament circuit 1 inactive, e.g.
- during start up
- during adap of large focus
- error condition
- single focus tube (using large only)

FI ON (filament circuit 2) :
on = filament circuit 2 active (large focus)
- if all ready conditions present, activates triac V36 on EZ119 for intermediate DC circuit

off = filament circuit 1 inactive, e.g.
- during start up
- during adap of small focus
- error condition

EN_STOP_X :
on =
off =

EN_X_ACT :
on = triggers the mAs counter
off =

GRID control :
on =
off =

GRID mode :
on =
off =

- **Error: Read HW Values**

IF nominal (filament circuit 1) [mA]: filament current setpoint small focus
(see table page 21)

IF nominal (filament circuit 2) [mA]: filament current setpoint large focus
(see table page 21)

IF actual (filament circuit 1) [mA]: filament current actual value small focus
measuring point EZ119 X5 - (X8 gnd) 2.5A / V

IF actual (filament circuit 2) [mA]: filament current actual value large focus
measuring point EZ119 X7 - (X8 gnd) 2.5A / V

intermed circuit voltage (fil. cir. 1) [V]: intermediate DC supply of filament converter 1
small focus (typically 325VDC)

intermed circuit voltage (fil. cir. 2) [V]: intermediate DC supply of filament converter 2
large focus (typically 325VDC)

FU-mA version : hardware version of FU_mA

CAN identifier : address of unit on the CAN bus
ignore for troubleshootimg

CTRL_X_C : on / off = status of CTRL_X_C/ signal during event

X_ACT_S : on / off = status of X_ACT_S/ signal during event

- **Error: Specific Informations**

  might display information if relevant for event

- **Functional Tests**

  - **test watchdog**

    activates watchdog of FU_mA, red LED turns on and remains on, activate warm reset to restart generator
    no PC access & communiaction during this (FATAL ERROR) status

- **Monitoring**

  - **read If nominal**

    type in filament number, see table *'focus number FU-mA'* page 21

  - **read If actual**

    type in filament number, see table *'focus number FU-mA'* page 21

  - **read intermed circuit voltage**

    type in filament circuit, see table *'filament converter on FU-mA EZ119'* page 21

  - **read Ie measuring trace**

    A 'table' of 100 individual screen comes up, screen 1/100 is the last value being taken, 100/100 the oldest.
    The mA value is measured every 2 ms. With low mA values (e.g. during fluoro or low-mAs tomo) there might be several 0mA entries.

  - **read 8 bit port**

    ignore for troubleshooting

  - **read 16 bit port**

    ignore for troubleshooting

  - **read memory**

    ignore for troubleshooting

- **Read Ie corrections**

foc filament number, see table *'focus number FU-mA'* page 21

Ie offset valid usual display: Ie offset O.K.

correction active default display: Ie offset corr. active
if tube adapted: Ie offset + R corr. active

ofs [uA] default mA offset current value of mA measuring circuit PCB G100 = 4000uA
corrected value appears after adaptation

R [MOhm] default value (no tube or not adapted) = 0 MOhm
corrected (measured during adaptation) value should be close to 200 MOhms
this value is required to be filled in the mAs correction formula, see doc ACCEPTANCE

- **Adaptation Results**

  - **Select Adaptation Table for Reading**

    Only possible with an adapted filament.

    focus: type in filament number, see table *'focus number FU-mA'* page 21

    U [kV]: type in a kV value between 40...150kV (within the limits)

  - **Read Previously Selected Adaptation Table**

    Displays tables of different sizes (kV stage dependent) after the filament has successfully been adapted.
    Screen (or value line) 1/xx always displays the individual standby filament current at 100uA.
    Screen xx/xx displays a filament current which is just one step obove the maximum emission current.

    If [mA] : filament current
    lowest value = standby filament current
    highest value = upper filament current limit + a little bit on top

    table size depends on the filament current mA steps (individual for every kV stage)

    Ie [uA] : emission current at the given filament current

    boost time [ms] : how long it takes to boost up from a specific emission current (filament temperature) to a higher emission current (higher temperature) with the boost current = max filament current + 2A (positive boost)

    blank time [ms] : how long it takes for the filament to 'cool down' from a specific emission current to a lower emission current (negative boost)

    to get to a lower mA value the filament current goes down to 0.5A

(0.5A is required as lowest current to feed a grid switch unit, if present)

typically the negative boost time is 2-3 times positive boost time

- **Select Unit**
  - **FU - kV**
    - **Adjust**
      - **IGBT Pulse Width Correction**

        see doc ADJUSTMENTS

        has to be carried out

        - after high tension tank replacement
        - after converter replacement (1 or 2)
        - after replacement of PCB kV_control EZ130
        - after exchange of PCB CU if no CU Complete CMOS backup is available (value is stored in CU memory)
    - **Faultfind**
      - **Power On Results**
        - **Read Configuration**

          mains identifier : 1 = 3 phases
          0 = 1 phase (if signal SI_PH/ low active EZ130 X1:C14)

          power identifier : 0 = 50kW
          1 = 100kW
          2 = 65kW
          3 = 80kW

          control PCB identifier :

          maximum tubes : 1...3
      - **Logging Tables**
        - **Read Trace** max 10 entries possible

          time [ms] time [ms] after turn-on

          source-id multiple entries, to be continued

          information multiple entries, to be continued
        - **Read Error**
          - **Error: Info**

            class :

            error code :

            error explanation :

            task name :

            procedure name :

previous warning :

previous explanation :

parameter :

error time [ms] :

- **Error: Trace**

  time [ms] time [ms] after turn-on

  source-id multiple entries, to be continued

  information multiple entries, to be continued

- **Error: HW Set Values**

  kV nominal (DAC) [kV] : setpoint of kV (Cockpit parameters)

  Z nominal vaule (DAC) [%] : duty cycle, load dependent

  converter control : reset
  normal work
  standby test
  prep test

  grid mode : no / yes (grid switch mode not yet available)

  high tension command : disable / enable

  power relay : on / off = ENK1 energized

  tube : 1 of 1...3

- **Error: Read HW Values**

  kV anode [kV] : actual value kV anode

  kV cathode [kV] : actual value kV cathode

  E value [V] : converter DC supply
  range (without warning) 400...780VDC

  converter 1 temperature ['C] : range without warning 0'C...85'C

  converter 2 temperature ['C] : range without warning 0'C...85'C
  only with 65/80kW
  with 50kW versions -273'C (line open)

  ht-tank temperature ['C] : range without warning 0'C...80'C

  selected tube : 1 of 1...3

  grid mode : no / yes (grid switch mode not yet available)

  EN_X_C : on / off

XACT_S | CTRL_X_C : on / off | on / off

tube arcing : yes / no

over voltage : yes / no

mains identifier : 3 phases
1 phase

power identifier : 10 = 1 converter (50kW)
00 = 2 converter (65/80kW)

power2 identifier : 00 = standard converter

control PCB identifier :

IGBT type identifier : Siemens
Toshiba (default, version will be identified during error)

- **Error: Specific Information**

might come up like (other entries possible):

act: kV anode during divider test [kV] : = actual value of what appears in the text
min: kV anode during divider test [kV] : = min deviation value of setpoint value
max: kV anode during divider test [kV] : = max deviation value of setpoint value

- **Functional Tests**

  - **Test Watchdog**

activates watchdog of FU_kV, red LED turns on and remains on, activate warm reset to restart generator
no PC access & communiaction during this (FATAL ERROR) status

  - **Test DAC - ADC**

Start function: execution <OK> starts the digital - analog - digital test of the kV setpoint and the duty cycle channel
typically warnings/errors are logged afterwards

kV deviation [%] : result of measurement

allowed [%] : max deviation value, default 3 %

Z deviation [%] : result of measurement

allowed [%] : max deviation value, default 3 %

  - **Test Converter**

see doc FAULTFINDING

if DC value (E-value) too high, test will be cancelled

  - **Switch Error Handling**

break on error : yes / no to be continued

- **Monitoring**

  - **Measure Temperatures**

    tube temp switch : short circuit (against ground), blinking overtemperature at Cockpit
    closed = normal condition, ready at Cockpit
    open = open cable connection / tube too hot,
    blinking overtemperature at Cockpit

    tube sensor ['C] : not yet available, ignore

    converter 1 ['C] : range without warning 0'C...85'C

    converter 2 ['C] : range without warning 0'C...85'C
    only with 65/80kW
    with 50kW versions -273'C (line open)

    ht-tank ['C] : range without warning 0'C...80'C

  - **kV Measurements**

    to be continued

  - **Converter Measurements**

    requested kV [kV] : value as set on the Cockpit

    kV nominal (ADC) [kV] : kV nominal, measument only during exposure possible with exposure times > 2000ms

    kV actual [kV] : total kV actual value, measument only during exposure possible

    kV anode [kV] : kV anode actual value, measument only during exp. possible

    kV cathode [kV] : kV cathode actual value, measument only during exp. possible

  - **Read 8 Bit Port**

    ignore for troubleshooting

  - **Read 16 bit Port**

    ignore for troubleshooting

  - **Read Memory**

    ignore for troubleshooting